

Freshwater Standards Rule Revision

**MTCA/SMS Advisory Group
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Freshwater Standards

Goals For Today

- ❑ Present policy framework**
- ❑ Present biological and chemical criteria proposal and framework**
- ❑ Identify and discuss implementation and policy issues**

Freshwater Standards Policy Framework

- ❑ Consistency with current SMS regulatory framework.
- ❑ Biological and chemical criteria.
- ❑ Two tier structure: SQS and CSL.
- ❑ Allowance of some adverse effects.
- ❑ Biological override.
- ❑ Adoption of cleanup standards only.

Freshwater Biological Standards

Regulatory Framework

- ❑ Confirmatory bioassays trump chemistry
- ❑ Two tier structure: SQS and CSL
- ❑ Biological suite – Minimum of 3 tests
- ❑ Multiple species/sensitive life-history stages
- ❑ Both acute and chronic tests

Freshwater Biological Standards

□ Bioassay suite to include at least:

- 3 Endpoints
- 2 Species
- 1 Chronic Test
- 1 Sublethal Endpoint



■ Interpretation

- SQS: Single SQS level hit
- CSL: 2+ SQS level hits; 1+ CSL level hit

History of Freshwater (FW) SQG Development

- **Early work on FW Apparent Effects Thresholds (AETs) & Floating Percentile Method (FPM; Portland Harbor) throughout the late 1990s**
- **2002 – Formal evaluation of FW AETs and other existing SQG sets (TELs/PELs, etc.)**
- **Decision that a new approach was needed:**
 - **FW AETs not sufficiently conservative**
 - **TELs/PELs, etc., greatly overpredict toxicity**
 - **National evaluations were not looking at both types of statistical errors**

Statistical Digression

- **False Negative** = Predicting that a sample will be non-toxic when it is actually toxic
- **False Positive** = Predicting that a sample will be toxic when it is actually non-toxic

Existing national methods were focused on reducing False Negatives at lower screening levels and False Positives at upper screening levels, creating substantial errors and inefficiencies in between, where most actual data are located.

We focused on reducing both types of errors at the same time, for all levels of effects.

Floating Percentile Method

- **Goal:** Minimize false negatives and false positives simultaneously
- **Approach:**
 - Data QA, screening, and summing
 - Identify true toxicity based on bioassays
 - The model searches for the most predictive results, allowing each chemical to move independently to the level at which it appears to be toxic

Data Set – Chemistry

- **Oregon and Washington**
- **West and east of the Cascade Mountains**
- **Lakes, rivers, small and large**
- **Various geochemical environments**
- **50 analytes and sums → 105 chemicals**
- **Rigorous QA/QC applied**

Data Set – Bioassay Endpoints

- **Hyalella 10-day mortality – 366**
- **Chironomus 10-day mortality – 550**
- **Chironomus 10-day growth – 504**
- **Hyalella 28-day mortality – 319**
- **Hyalella 28-day growth – 79**

FPM Runs & Issues Tested

- East side vs. west side vs. combined
- TPH vs. PAH vs. combined
- Microtox – include?
- *Hyalella* growth – include Portland Harbor?
- Ammonia and sulfides issues
- N-qualified pesticides
- Blank-correction standardization
- Control vs. reference
- Revision of bioassay interpretive criteria

Table 3-7. Selection of Recommended Sediment Quality Guidelines

Analyte	Distribution of Floating Percentile Model Values ^a										SL1/SQS ^b	SL2/CSL ^c
Conventional Pollutants (mg/kg)												
Ammonia	230	300	> 780	> 780	> 780	> 780					230	300
Total sulfides	39	61	340	340	360	540	920	920			39	61
Metals (mg/kg)												
Antimony	0.3	0.3	12	42	42	42	42	> 63			0.3	12
Arsenic	14	14	16	16	120	120	120	180	200	200	14	120
Cadmium	2.1	2.1	5.4	6.3	6.3	13	13	> 23	> 23	> 23	2.1	5.4
Chromium	72	72	82	88	220	220	220	> 350	> 350		72	82
Copper	400	1200	1600	1600	1900	1900	> 1900	> 1900	> 11000		400	1200
Lead	360	360	> 1300	> 1300	> 1400	> 1400	> 1400	> 1400	> 1400	> 1400	360	> 1300
Mercury	0.66	0.66	0.8	0.8	0.8	0.87	0.87	> 0.87	3.04		0.66	0.8
Nickel	26	> 27	> 100	> 100	110	110	360	360	> 590	> 590	26	110
Selenium	11	11	> 20	> 20	> 20	> 20					11	> 20
Silver	0.58	0.64	1.7	1.7	4.1	4.1					0.58	1.7
Zinc	3200	3200	3200	> 4200	> 4200	> 14400	> 14400	> 14400			3200	> 4200
Organic Chemicals (µg/kg)												
4-Methylphenol	260	260	2000	2000	2400	2400	> 6300	> 6300			260	2000
Benzoic acid	2900	3800	3800	4100							2900	3800

- “>” values- no toxicity observed for that endpoint up to the listed concentration. Sample concentrations at or above this level should undergo toxicity testing.
- BPJ call regarding selection of CSL/SL2: “next significantly different value”.

Past and current peer review

- 5 national/regional scientific conferences (1999-2009)
- DEQ-led peer review/public meetings during Portland Harbor (2001 state site)
- Public/agency review of 2003 Ecology report
- Presentations at 4 SMARMs (2003-2010) + numerous RSET public meetings
- Ecology/DEQ internal/management review (2010)
- Sediment Workgroup and RSET review

Freshwater Standards

Next Steps

- ❑ Continued peer review of standards**
- ❑ Science Panel peer review of standards**
- ❑ Complete draft rule language**
- ❑ EPA review**
- ❑ Formal public review**

Freshwater Standards

Input from MTCA/SMS AG

- ❑ Consistency with SMS framework.**
- ❑ Two tier structure at SQS and CSL level.**
- ❑ Balance of false positives/false negatives for higher reliability.**
- ❑ Same bioassays used to develop SQVs and used for biological standards.**

Freshwater Standards

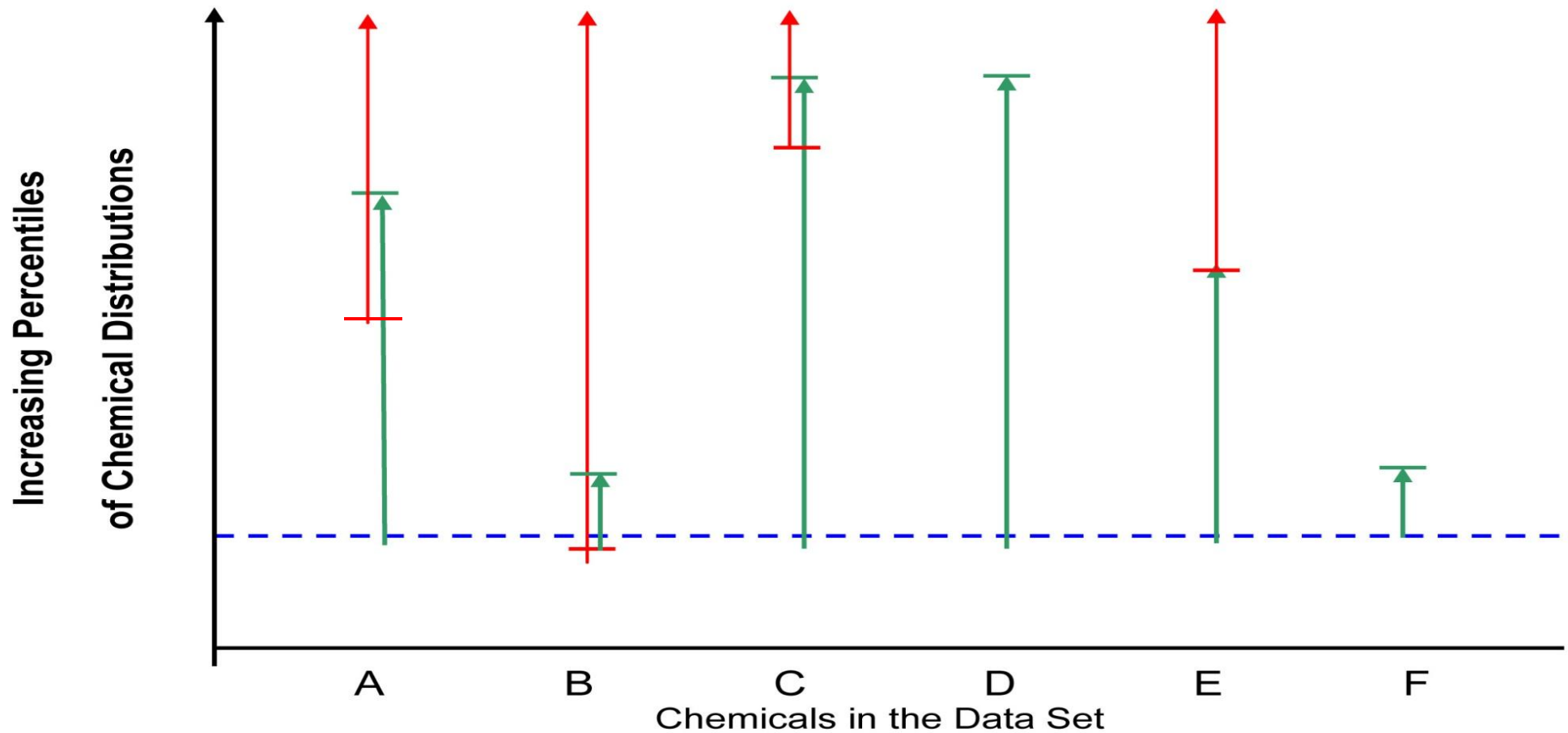
Input from MTCA/SMS AG

- ❑ Chemical criteria not universally applicable at all sites.**
- ❑ Bioassay override where unique conditions preclude use of chemical criteria.**
- ❑ Apply standards to cleanup and/or source control sections of the rule.**



Questions?

Figure 2-1. Floating Percentile Method



Legend:

----- Fixed percentile for all chemicals



Region within which false positives occur



Toxicity range within and above which false negatives occur

Reliability

- Sensitivity (100% – false negatives)
- Efficiency (100% – false positives)
- Predicted no-hit reliability
- Predicted hit reliability
- Overall reliability

All measures of reliability were used for ALL effects levels (see p. 14 for diagram)

Table 3-3. Reliability of the FPM Results and Existing SQG Sets at the SQS/SL1 Level

a. Chironomus 10-day growth

FPM FN Percentiles	% False Negatives	% False Positives	Hit Reliability	NoHit Reliability	PredHit Reliability	PredNoHit Reliability	Overall Reliability
5	4.6	44.8	95.4	55.2	23.1	98.8	60.2
10	9.2	35.9	90.8	64.1	26.3	98.0	67.4
15	13.8	31.7	86.2	68.3	27.7	97.2	70.5
20	20.0	17.0	80.0	83.0	40.0	96.7	82.7
25	24.6	19.6	75.4	80.4	35.3	95.9	79.8
30	29.2	13.5	70.8	86.5	42.6	95.4	84.6

SQG	% False Negatives	% False Positives	Hit Reliability	NoHit Reliability	PredHit Reliability	PredNoHit Reliability	Overall Reliability
ERL	6.2	85.9	93.8	14.1	13.4	94.2	24.0
TEL	4.6	91.3	95.4	8.7	12.9	93.0	19.4
TEC	7.7	79.6	92.3	20.4	14.1	94.9	29.3
LEL	9.2	88.3	90.8	11.7	12.7	90.0	21.5

Freshwater Standards Reliability

For SL1

	% False Negatives	% False Positives	% Overall Reliability
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acute endpoint (mortality)

FPM	19	22	79
others	7	86	33

sub-lethal endpoints (growth)

FPM	20	18	82
others	8	88	29

Values are averages
across relevant assays

For SL2

	% False Negatives	% False Positives	% Overall Reliability
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acute endpoint (mortality)

FPM	22	15	84
others	36	36	64

sub-lethal endpoints (growth)

FPM	18	13	87
others	40	37	63

Test	QA limits Control	QA limits Reference	SQS	CSL
<u>Hyaella azteca</u>				
*10-day mortality	$C \leq 20\%$	$R \leq 25\%$	$T - R > 15\%$	$T - R > 25\%$
*28-day mortality	$C \leq 20\%$	$R \leq 30\%$	$T - R > 10\%$	$T - R > 25\%$
**28-day growth	$CF \geq 0.15 \text{ mg/}$	$RF \geq 0.15 \text{ mg/}$	$T/R < 0.75$	$T/R < 0.6$
<u>Chironomus dilutus</u>				
*10-day mortality	$C \leq 30\%$	$R \leq 30\%$	$T - R > 20\%$	$T - R > 30\%$
**10-day growth	$CF \geq 0.48 \text{ mg/}$	$RF/CF \geq 0.8$	$T/R < 0.8$	$T/R < 0.7$
*20-day mortality	$C \leq 32\%$	$R \leq 35\%$	$T - R > 15\%$	$T - R > 25\%$
**20-day growth	$CF \geq 0.48 \text{ mg/}$	$RF/CF \geq 0.8$	$T/R < 0.75$	$T/R < 0.6$
<u>Microtox®</u>				
**15min decrease in luminescence	$CF/CI \geq 0.72$	$RF/CF \geq 0.8$	$T/R < 0.85$	$T/R < 0.75$

Bioassay and Endpoint Definitions

Test	Acute Bioassays	Chronic Bioassays	Lethal Endpoint	Sublethal Endpoint
<i>Hyalella azteca</i>				
10-day mortality	X		X	
28-day mortality		X	X	
28-day growth		X		X
<i>Chironomus dilutus</i>				
10-day mortality	X		X	
10-day growth	X			X
20-day mortality		X	X	
20-day growth		X		X
MicroTox				
100% PoreWater		X?	X	